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OCCASIONAL PAPER NO. 88 DECEMBER 27, 1939

SOUTHERN FOREST EXPERIMENT STATION

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New Orleans, La.

FIRE-DISCOVERY TIME IN THE LONGLEAF-SLASH PINE TYPE

by

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and
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The Occasional Papers of the Southern Forest Experiment Station present information on current Southern forestry problems under investigation at the Station. In some cases these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

FIRE-DISCOVERY TIME IN THE LONGLEAF-SLASH PINE TYPE

By C. A. Bickford, Associate Silviculturist,
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The studies of rate of spread in the longleaf-slash pine type have provided a basis for estimating perimeters of fires burning under various conditions of weather and fuel and thus indirectly for determining the suppression action to be taken. For use on a specific fire, it is necessary to estimate either the time between origin and discovery (here called the discovery time) or the size of the fire when discovered. This estimate is a necessary link in the chain between the discovery of a fire and the departure of a crew to suppress it.

Results of 142 observations made on fires that were set mainly on the Biloxi Ranger District to measure rate of spread, showed that the average discovery time was nearly 10 minutes. It is better to use this average than a pure guess or than to make no allowance for the time interval between origin and discovery, but since it is obvious that a fire will be discovered sooner under favorable than under poor discovery conditions, it was decided to make a special study so that discovery time could be estimated under all conditions. In this study, therefore, which was undertaken to provide a means of estimating, in the longleaf-slash pine type, the discovery time of fires and their size when discovered, fires were set intentionally in 43 different places on the De Soto National Forest in southern Mississippi.

In making test fires, areas for the fires were chosen to give a minimum of suppression difficulty, but were selected at some distance from commonly travelled routes or occupied dwellings, in order to avoid any aggravation of the local fire-prevention problem. The selected areas were then located on the forest map[1] as accurately as possible without a formal survey. Six towers on or near the Biloxi Ranger District participated in this study; four of these were operated by the De Soto National Forest and two by the Mississippi Forest Service. All six towers were equipped in essentially the same manner; five used an Osborne fire finder, but none used hazemeters or binoculars. All kept a diary and daily log and had immediate access to a telephone (not a public line).

Arrangements were made with the local fire dispatcher for scheduled radio communication; all watches were set with the dispatcher's clock; and the weather instruments and radio were set up for use. Two fuel samples were taken by clipping grassy and other herbaceous fuel just above the ground surface. The area selected for burning was then staked at 1-chain intervals with small bamboo poles (flagged with various colors for speedy identification).

1/ The maps of the Biloxi and Leaf River Ranger Districts were prepared from aerial surveys, which made location to the nearest "forty" easy and positive.

When all these preliminaries were completed and checked, radio[2/] communication was established with the dispatcher, who notified the field radio operator that he was ready. This operator then blew a whistle to signal the head mapper to start the fire and to begin the records with the weather instruments. As the fire spread, the radio operator stood by for word from the dispatcher that the fire had been discovered, the weather-instrument man took measurements of wind movement with the anemometer[3/] at 1-minute intervals, and the mappers extended the staking system as needed at the head of the fire.

The towermen concerned did not know these plans and reported the test fires to the dispatcher as soon as detected exactly as they would any other fire. Both the first and second discoveries by towermen were reported to the field party, who marked the perimeters at the time of these discoveries with bamboo stakes. When discovery by the second towerman was reported, the fire was extinguished, and the radio operator obtained the essential data on discovery from the two (or three) towermen who reported the smoke. These data included name of tower, azimuth reading, distance of fire from each reporting tower, and visibility distance in the direction of the fire. Visibility distance is an ocular estimate made by the towermen, who used objects at known distances for reference.

When the fire was out, the two perimeters (at first and second discovery) were mapped and measured, guided by the bamboo stakes. The instruments were then taken down and the field party was ready to select another area for a test fire.

The moisture content of the fuel samples was determined in the field headquarters at the Harrison Experimental Forest.[4/] Here also the mapped perimeters were checked, and the areas were measured with a planimeter. Separate correlation analyses were made, using time of discovery in minutes, perimeter at time of discovery in chains, and area at time of discovery in acres as dependent variables.

Reviewing the independent variables, it seemed reasonable to expect discovery time to vary as a joint function of (a) distance from fire to tower and (b) visibility distance. That is, as the distance from fire to tower increases with respect to visibility distance, discovery time should also increase; while as visibility distance increases with respect to distance from fire to tower, discovery time should decrease. This suggested using the ratio of the actual distance to the visibility distance as an independent variable, rather than using actual distance and visibility distance as two separate independent variables.

2/ The radio used in this study was a standard Forest Service set (type SPF radiophone) borrowed from the De Soto National Forest.
3/ The instrument used was a portable Biram anemometer. (See "Rate of spread of surface fires in the ponderosa pine type of California," by J. R. Curry and W. L. Fons. Jour. Agr. Res. 54 (4): fig. 2, p. 243. 1938.)
4/ Moisture content used in this study is percentage of dry weight; the drying was done with a Moisture Teller, an electrical device which blows warmed air through the sample.

This correlation proved to be significant (M = 8.66; σ_{EST} = 5.78; R = 0.437). Since the regression equation gave a relatively poor estimate, graphic tests for curvilinearity were made. A definitely curved relationship was shown between actual and estimated discovery time, in which actual exceeds estimated in both the low and high values but is less than estimated in the middle values. This means, in effect, that the influence of rate-of-spread index on discovery time is different for different ratios of actual distance to visibility distance. This seems reasonable in retrospect, since if the ratio of actual distance to visibility distance is relatively small (i.e., actual distance is small and visibility distance is large), it is to be expected that discovery time will be relatively small (short) for essentially all rate-of-spread indices. Similarly, when the ratio of actual distance to visibility distance is large (actual distance is large and visibility distance is small), discovery time should be large (long). When the ratios of actual distance to visibility distance are medium (i.e., when visibility distance is 1 to 3 times the actual distance), discovery time is much more affected by the rate-of-spread.

A curve was fitted to the data, in which actual discovery time was plotted over estimated discovery time. This was used as the graduating curve for the second estimate, a check of which showed that there were consistent and small underestimates in the lower values of discovery time.

A new curve was then drawn, and a third estimate was made; this is still not perfect, but further refinement seems unwarranted. In this step, the estimates of discovery time have been improved by reducing the curvilinearity and by increasing the correlation (ρ = 0.651, and σ_{EST} = 5.02 for the third estimate, compared with R = 0.437 and σ_{EST} = 5.78 for the first estimate).

The end product of this analysis is the accompanying alinement chart. It will be noted that discovery time on this chart is not graduated for less than 6.3 minutes. It is not to be inferred from this that fires cannot be discovered in less time; it does mean, however, that with the observed data, discovery time was too erratic to be satisfactorily estimated from the variables that were used, if the estimate of time is less than 6.3 minutes. The average of the 43 first discoveries was 6.93 minutes, whereas the average of the 86 independent (first and second) discoveries was 8.66 minutes.

It should be noted that most of the fires were set on days with good or fair visibility and had low to moderate rates of spread. It is obviously impracticable to set test fires on days when the rate of spread is high. This, together with the fact that the scanning time may form a large portion of the discovery time, prevents even reasonably accurate estimates below 6.3 minutes.

Similar analyses were made using perimeter at discovery and area at discovery as dependent variables. Both showed significant correlations, but neither was as good as the estimate of discovery time. Furthermore, discovery time is more useful because, if it is known, the perimeter can be

estimated by using the rate-of-spread index, which may be read directly from the danger meter.

The study of discovery time has shown a definite correlation between discovery time and rate-of-spread index and the ratio of tower distance to visibility distance. This provides a means of estimating the discovery time of fires at various distances, if the visibility distance and the rate of spread are known. The discovery time, thus estimated, may then be combined with the expected travel time and the rate-of-spread index to estimate the size of fires when the suppression crew arrives. Furthermore, when more information is obtained on held-line construction, it may be possible to make a direct estimate of the number of men to send to any given fire.

Note: Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration Official Project 65-2-64-74.

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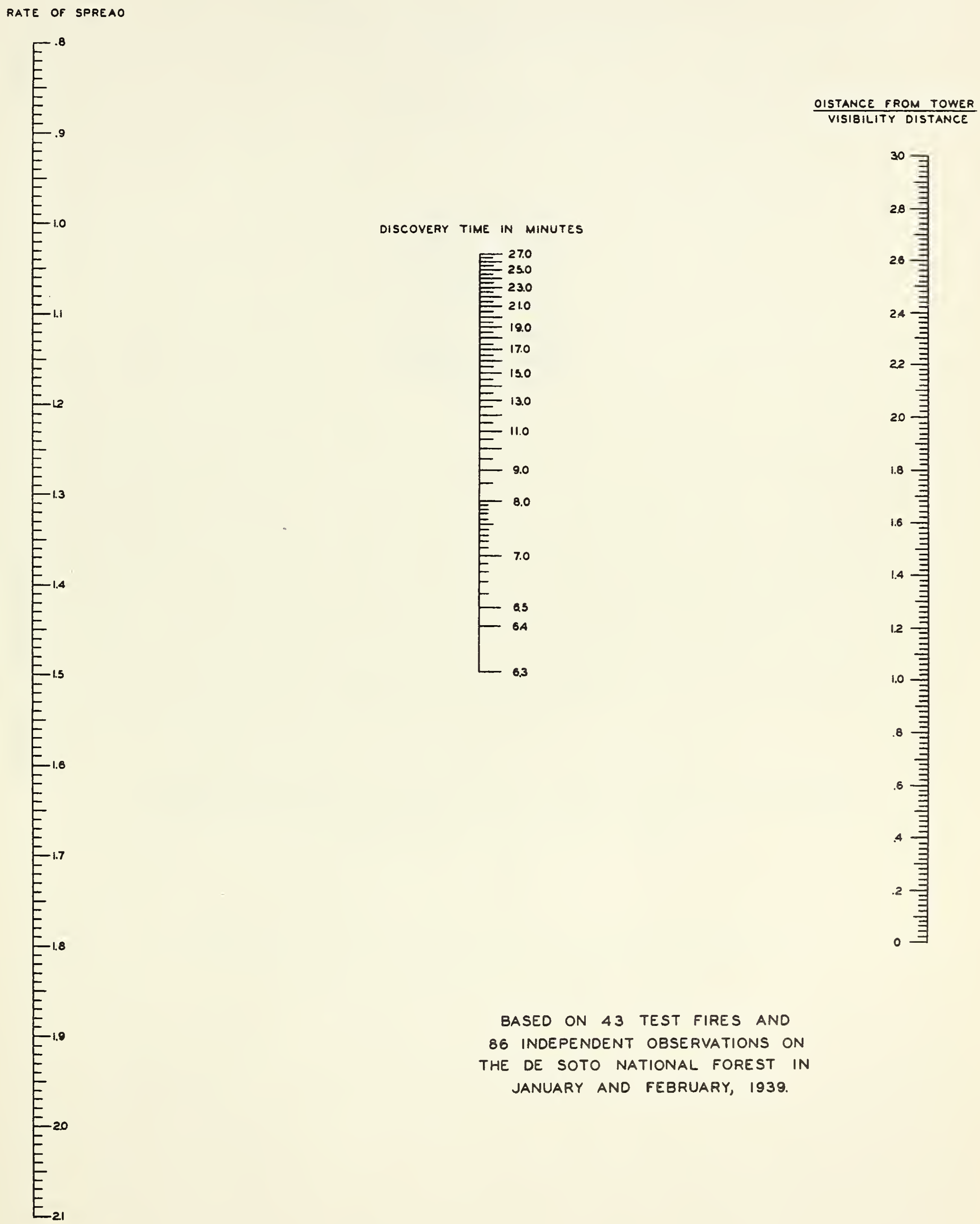
ALINEMENT CHART OF DISCOVERY TIME IN THE LONGLEAF-SLASH PINE TYPE, AS ESTIMATED FROM RATE OF SPREAD, VISIBILITY DISTANCE, AND DISTANCE FROM FIRE TO TOWER



BASED ON 43 TEST FIRES AND 86 INDEPENDENT OBSERVATIONS ON THE DE SOTO NATIONAL FOREST IN JANUARY AND FEBRUARY, 1939.